REMARKS

The present Amendment amends claims 11, 16, 21, 24 and 27, and leaves claims 22, 14, 15, 17, 19, 20, 22, 25, 26, and 29-30 unchanged. Therefore, the present application has pending claims 11, 12, 14-17, 19-22 and 24-30.

35 U.S.C. §103 Rejections

Claims 11, 12, 14-17, 19-22 and 24-30 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,210,866 to Milligan et al. ("Milligan") in view of U.S. Patent No. 5,459,857 to Ludlam et al. ("Ludlam"), and further in view of U.S. Patent No. 6,252,514 to Nolan ("Nolan"). This rejection is traversed for the following reasons. Applicants submit that the features of the present invention, as now more clearly recited in claims 11, 12, 14-17, 19-22 and 24-30, are not taught or suggested by either of Milligan, Ludlam or Nolan, whether taken individually or in combination with each other in the manner suggested by the Examiner. Therefore, Applicants respectfully request the Examiner to reconsider and withdraw this rejection.

Amendments were made to the claims to more clearly describe features of the present invention. Specifically, amendments were made to the claims to more clearly recite that the present invention is directed to a computer system, a storage system, and a method of data recovery as recited, for example, in independent claims 11, 16, 21, 24 and 27.

The present invention, as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27, provides a computer system. The computer system includes: a host computer; and a storage system storing data accessed by the host computer.

According to the present invention, the storage system includes a first physical storage area in one or more disks in the storage system and a controller for accessing the one or more disks in the storage system, the first physical storage

area corresponds to a first logical volume accessed by the host computer, and the host computer stores data in the first physical storage area, and stores a backup copy of the data at a certain point in time.

Also according to the present invention, after the certain point in time, upon occurrence of a failure in a sequence of processing executed by the host computer, the host computer selects an unused second logical volume in the storage system, the second logical volume corresponding to a second physical storage area in the one or more disks, reads the backup copy of the data made at the certain point in time and writes the backup copy of the data to the second logical volume.

Furthermore, according to the present invention, the host computer issues a swap request to the storage system, the swap request exchanging positional information of the first logical volume with that of the second logical volume, so that data of the first logical volume is interchanged with data of the second logical volume and the controller accesses the second physical storage area when the controller receives an access request to the first logical volume from the host computer.

Further, according to the present invention, the storage system sets a value of a device busy request of the positional information of each of the first logical volume and the second logical volume to indicate busy when the storage system receives the swap request from the host computer, and the storage system issues a device busy request to the host computer, so as to keep consistency of the first logical volume and the second logical volume, when the storage system receives an access request to the first logical volume or the second logical volume from the host computer upon processing the swap request for the first logical volume and the second logical volume. The prior art does not teach or suggest all of these features.

The above described features of the present invention, as now more clearly recited in the claims, are not taught or suggested by any of the references of record.

Specifically, the features are not taught or suggested by either of Milligan, Ludlam or Nolan, whether taken individually or in combination with each other.

Milligan teaches an incremental disk backup system for a dynamically mapped data storage subsystem. However, there is no teaching or suggestion in Milligan of the computer system, the storage system, or the method of data recovery as recited in claims 11, 16, 21, 24 and 27 of the present invention.

Milligan discloses where a parallel disk drive array data storage subsystem dynamically maps between virtual and physical data storage devices and schedules the writing of data to these devices. The data storage subsystem functions as a conventional large form factor disk drive memory, using an array of redundancy groups, each containing N+M disk drives. The data storage subsystem does not modify data stored in a redundancy group but simply writes the modified data as a new record in available memory space on another redundancy group. The original data is flagged as obsolete. A mapping table is maintained to identify portions of these redundancy groups which contain newly written or modified virtual track instances. These marked virtual track instances are written to backup medium as a background process and the mapping table is updated to clear the flags that identify these virtual track instances as having been modified.

One feature of the present invention, as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27, includes where the host computer issues a swap request to the storage system, the swap request exchanging positional information of the first logical volume with that of the second logical volume, so that data of the first logical volume is interchanged with data of the second logical volume and the controller accesses the second physical storage area when the controller receives an access request to the first logical volume from the host computer. Milligan does not disclose this feature.

For example, Milligan does not disclose issuing a swap request to the storage system, and the Examiner does not rely upon Milligan for teaching this feature. The Examiner relies upon Nolan for teaching a swap request, but as discussed in more detail below, Nolan does not teach issuing a swap request, where the swap request exchanges positional information, in the manner claimed.

Another feature of the present invention, as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27, includes where the storage system sets a value of a device busy request of the positional information of each of the first logical volume and the second logical volume to indicate busy when the storage system receives the swap request from the host computer, and where the storage system issues a device busy request to the host computer, so as to keep consistency of the first logical volume and the second logical volume, when the storage system receives an access request to the first logical volume or the second logical volume from the host computer upon processing the swap request for the first logical volume and the second logical volume. Milligan does not disclose this feature, and the Examiner does not rely upon Milligan for teaching this feature.

Therefore, Milligan fails to teach or suggest "wherein said host computer issues a swap request to said storage system, said swap request exchanging positional information of the first logical volume with that of the second logical volume, so that data of said first logical volume is interchanged with data of said second logical volume and said controller accesses said second physical storage area when said controller receives an access request to said first logical volume from said host computer" as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27.

Furthermore, Milligan fails to teach or suggest "wherein said storage system sets a value of a device busy request of said positional information of each of said

first logical volume and said second logical volume to indicate busy when said storage system receives said swap request from said host computer, and wherein said storage system issues a device busy request to said host computer, so as to keep consistency of said first logical volume and said second logical volume, when said storage system receives an access request to said first logical volume or said second logical volume from said host computer upon processing said swap request for said first logical volume and said second logical volume" as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27.

The above noted deficiencies of Milligan are not supplied by any of the other references of record, namely Ludlam, whether taken individually or in combination with each other. Therefore, combining the teachings of Milligan and Ludlam in the manner suggested by the Examiner still fails to teach or suggest the features of the present invention as now more clearly recited in the claims.

Ludlam teaches a fault tolerant disk array storage subsystem. However, there is no teaching or suggestion in Ludlam of the computer system, the storage system or the method of data recovery in a storage system as recited in claims 11, 16, 21, 24 and 27 of the present invention.

Ludlam discloses where a pair of operationally independent disk drive array data storage subsystems is used to emulate one or more physical devices shared between two control modules. The storage control units of the two data storage subsystems are interconnected by at least one data link to exchange control and data signals therebetween. The storage control units of both data storage subsystems are synchronized to maintain identical virtual device images of certain assigned virtual devices both of the data storage subsystems wherein the duplicated data records of the single virtual device are stored. The data records are therefore stored in available memory on both of the two data storage subsystems. Data is

exchanged over the data link to maintain consistency of the two sets of mapping tables.

One feature of the present invention, as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27, includes where the host computer issues a swap request to the storage system, the swap request exchanging positional information of the first logical volume with that of the second logical volume, so that data of the first logical volume is interchanged with data of the second logical volume and the controller accesses the second physical storage area when the controller receives an access request to the first logical volume from the host computer. Ludlam does not disclose this feature, and the Examiner does not rely upon Ludlam for teaching this feature.

Another feature of the present invention, as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27, includes where the storage system sets a value of a device busy request of the positional information of each of the first logical volume and the second logical volume to indicate busy when the storage system receives the swap request from the host computer, and where the storage system issues a device busy request to the host computer, so as to keep consistency of the first logical volume and the second logical volume, when the storage system receives an access request to the first logical volume or the second logical volume from the host computer upon processing the swap request for the first logical volume and the second logical volume. Ludlam does not disclose this feature.

For example, Ludlam does not disclose issuing a device busy request, in the manner claimed. In the present invention, a device busy request is issued to the host computer to protect data, thereby keeping the consistency of the first logical volume and the second logical volume. The term “busy” as recited in the claims, is

not the same as the term as disclosed in Ludlam. Ludlam merely discloses where if a selected virtual disk drive device 109 indicates busy in the initial status byte, a signal is sent to the host processor indicating this and the command is issued again by the host processor 101 a short time later. This is not the same as the present invention.

Therefore, Ludlam fails to teach or suggest "wherein said host computer issues a swap request to said storage system, said swap request exchanging positional information of the first logical volume with that of the second logical volume, so that data of said first logical volume is interchanged with data of said second logical volume and said controller accesses said second physical storage area when said controller receives an access request to said first logical volume from said host computer" as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27.

Furthermore, Ludlam fails to teach or suggest "wherein said storage system sets a value of a device busy request of said positional information of each of said first logical volume and said second logical volume to indicate busy when said storage system receives said swap request from said host computer, and wherein said storage system issues a device busy request to said host computer, so as to keep consistency of said first logical volume and said second logical volume, when said storage system receives an access request to said first logical volume or said second logical volume from said host computer upon processing said swap request for said first logical volume and said second logical volume" as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27.

The above noted deficiencies of Milligan and Ludlam are not supplied by any of the other references of record, namely Nolan, whether taken individually or in combination with each other. Therefore, combining the teachings of Milligan, Ludlam

and Nolan in the manner suggested by the Examiner still fails to teach or suggest the features of the present invention as now more clearly recited in the claims.

Nolan teaches a hot-swap assembly for computers. However, there is no teaching or suggestion in Nolan of the computer system, the storage system or the method of data recovery in a storage system as recited in claims 11, 16, 21, 24 and 27 of the present invention.

Nolan discloses an assembly that engages a component to a computer system includes a cover adapted to retain the component and to be inserted within a chassis of the computer system. A slide movably coupled to the cover has a proximal position associated with inserting the cover into the chassis and a distal position associated with withdrawing the cover from the chassis. A detector coupled to a lock and to the slide detects movement of the slide to actuate the lock. The lock is coupled to the slide and to the detector, and blocks movement of the slide towards the distal point when the lock is in an engaged state.

One feature of the present invention, as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27, includes where the host computer issues a swap request to the storage system, the swap request exchanging positional information of the first logical volume with that of the second logical volume, so that data of the first logical volume is interchanged with data of the second logical volume and the controller accesses the second physical storage area when the controller receives an access request to the first logical volume from the host computer. Nolan does not disclose this feature.

The Examiner relies upon Nolan for teaching where the host computer issues a swap request to the storage system. However, Nolan is quite different from the present invention. Nolan merely discloses a hot swap mechanism where an

administrator requests that failed hardware be swapped with new hardware. The swap request of Nolan is not the same as the swap request of the present invention.

In the present invention, the swap operation exchanges positional information of logical volumes, which is not the same as Nolan's swapping hardware. More specifically, unlike Nolan, the swap request of the present invention exchanges positional information of the first logical volume with that of the second logical volume, so that data of the first logical volume is interchanged with data of the second logical volume and the controller accesses the second physical storage area when the controller receives an access request to the first logical volume from the host computer. Therefore, the present invention distinguishes over Nolan.

Furthermore, the Examiner asserts that it would be obvious to combine Nolan with Milligan and Ludlam "to allow the communication of [a] swapping operation between computer devices/hosts with the associated storage system [to] be performed efficiently". However, the combination of Nolan with Milligan and Ludlam does not result in the present invention, namely where positional information of the first logical volume with that of the second logical volume is exchanged, so that data of the first logical volume is interchanged with data of the second logical volume and the controller accesses the second physical storage area when the controller receives an access request to the first logical volume from the host computer. Accordingly, the combination of Milligan, Ludlam and Nolan to obtain the present invention would not be obvious to one of ordinary skill in the art.

Another feature of the present invention, as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27, includes where the storage system sets a value of a device busy request of the positional information of each of the first logical volume and the second logical volume to indicate busy when the storage system receives the swap request from the host computer, and where the storage

system issues a device busy request to the host computer, so as to keep consistency of the first logical volume and the second logical volume, when the storage system receives an access request to the first logical volume or the second logical volume from the host computer upon processing the swap request for the first logical volume and the second logical volume. Nolan does not disclose this feature, and the Examiner does not rely upon Nolan for teaching this feature.

Therefore, Nolan fails to teach or suggest "wherein said host computer issues a swap request to said storage system, said swap request exchanging positional information of the first logical volume with that of the second logical volume, so that data of said first logical volume is interchanged with data of said second logical volume and said controller accesses said second physical storage area when said controller receives an access request to said first logical volume from said host computer" as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27.

Furthermore, Nolan fails to teach or suggest "wherein said storage system sets a value of a device busy request of said positional information of each of said first logical volume and said second logical volume to indicate busy when said storage system receives said swap request from said host computer, and wherein said storage system issues a device busy request to said host computer, so as to keep consistency of said first logical volume and said second logical volume, when said storage system receives an access request to said first logical volume or said second logical volume from said host computer upon processing said swap request for said first logical volume and said second logical volume" as recited in claim 11, and as similarly recited in claims 16, 21, 24 and 27.

Each of Milligan, Ludlam and Nolan suffer from the same deficiencies, relative to the features of the present invention, as recited in the claims. Therefore, combining the teachings of Milligan, Ludlam and Nolan in the manner suggested by

the Examiner does not render obvious the features of the present invention as now more clearly recited in the claims. Accordingly, reconsideration and withdrawal of the 35 U.S.C. §103(a) rejection of claims 11, 12, 14-17, 19-22 and 24-30 as being unpatentable over Milligan in view of Ludlam, and further in view of Nolan are respectfully requested.

The remaining references of record have been studied. Applicants submit that they do not supply any of the deficiencies noted above with respect to the references used in the rejection of claims 11, 12, 14-17, 19-22 and 24-30.

In view of the foregoing amendments and remarks, Applicants submit that claims 11, 12, 14-17, 19-22 and 24-30 are in condition for allowance. Accordingly, early allowance of claims 11, 12, 14-17, 19-22 and 24-30 is respectfully requested.

To the extent necessary, the applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of BRUNDIDGE & STANGER, P.C., Deposit Account No. 50-4888 (referencing Attorney Docket No. ASA-901-02).

Respectfully submitted,

BRUNDIDGE & STANGER, P.C.

/DONNA K. MASON/
Donna K. Mason
Registration No. 45,962

DKM/kah
(703) 684-1470